EFFECT OF SEED TREATMENT ON GERMINATION *OF BIPOLARIS ORYZAE* INFECTED RICE SEEDS DURING STORAGE

U. S. Monira[1*], M. A. Ali[2], M. R. Islam[3], R. Parvin[4] and M. Arifunnahar[5]

[1] *Principal Seed Technologist & Research Coordinator, Supreme Seed Company Ltd.*
[2] *Professor, Bangladesh Agricultural University, Mymensingh*
[3] *Professor, Bangladesh Agricultural University, Mymensingh*
[4] *Assistant Seed Technologist, Supreme Seed Company Limited*
[5] *Scientific Office, Plant Pathology Division, BARI*
[*]**Corresponding author:** monira@surovigroup.com

ABSTRACT

Monira, U. S., Ali, M. A., Islam, M. R., Parvin, R. and Arifunnahar, M. 2019. Effect of seed treatment on germination of *Bipolaris oryzae* infected rice seeds during storage. Bangladesh J. Plant Pathol. 35(1&2):19-26

Seeds of three hybrid rice varieties viz. Heera-1, Heera-2 and Heera-5 were collected from 15 different blocks of Supreme Seed Company limited along with one high yielding variety BRRI dhan29 from different farmer's field at Mymensingh district. Germination of *Bipolaris oryzae* infected rice seeds during 5 years storage after seed treatment with Vitaflo 200FF was studied in Seed Pathology Centre, Bangladesh Agricultural University and Central Laboratory, Supreme Seed Company Ltd. during June, 2012 to June, 2016. Low germination percentage was recorded as 77%, 70%, 75% and 62% when incidence of *B. oryzae* was observed 20%, 25%, 21% and 37% in-case of Heera-1, Heera-2, Heera-5 and BRRI dhan29 rice seed, respectively. After seed treatment with Vitaflo 200FF (3 ml/kg), no incidence of *B. oryzae* was found and thereby higher germination was recorded as 92% in Heera-1, 88% in Heera-2, 88% in Heera-5 and 92% in BRRI dhan29. After five years of storage highest germination of *B. oryzae* infected hybrid rice was recorded when seed treated with Vitaflo 200 FF and kept in poly bag under dehumidified condition with the corresponding values as 88%, 86%, 90% and 85% for Heera-1, Heera-2, Heera-5 and BRRI dhan29, respectively.

Key words: Seed treatment, *Bipolaris oryzae*, germination, hybrid rice

INTRODUCTION

Rice feeds more than half of the world's population and therefore, plays a very important role in food security and poverty alleviation. Quality seed is the crying need of the day. Health is not considered as a parameter of seed quality. But infected unhealthy seeds, harboring seed-borne pathogens, fail to germinate or the young seedlings emerging from the infected seeds die after germination resulting post-emergence death or damping off and seedling blight. Rice suffers from more than 60 different diseases (Fakir *et al.* 2002). In Bangladesh, brown spot pathogen *Bipolaris oryzae* is predominant (Mia *et al.* 2004). The pathogen is responsible for germination failure, rotting of seeds, roots and coleoptiles, poor germination and poor seedling vigour (Mia and Nahar 2001, Naeem *et al.* 2001, Malavolta *et al*. 2002). The diseases are severe where plants grown under stress conditions causing appreciable yield loss (Kamal and Mia 2009). It affects the quality and the number of grains per panicle and reduces the kernel weight (Mew and Gonzales 2002). In storage, it affects seed quality parameters like germination, viability and vigour. At the time of seed germination, it affects both root and shoot system and affects the survivability of seedlings by causing seedling blight. At reproductive phase, the nature of damage is in the form of grain discoloration, poor grain filling and reduced yield (Huynh and Gaur 2004). As *B. oryzae* is a seedborne pathogen in nature, besides management of the diseases through cultural practices, field chemical control and chemical seed treatment has been considered commonly in controlling *B. oryzae* and other seed-borne fungi in rice (Ahmed *et al.* 2000, Parisi *et al.* 2001). Seed deterioration during storage is a gradual and inevitable process causing considerable losses. The main constraints in storage are high temperature and moisture which affect the maintenance of seed quality in storage. *Bipolaris oryzae* is known to cause damage at different stages like, storage, seed germination and seedling establishment, vegetative growth and reproductive phase. As a result, productivity and quality of grains and seeds can be reduced considerably during production. The present study therefore, was aimed to determine the

effect of seed treatment with Vitaflo 200FF on germination of *Bipolaris oryzae* infected rice seeds during storage.

MATERIALS AND METHODS

Germination of *Bipolaris oryzae* infected seeds

Seed germination with *Bipolaris oryzae* was studied at the Seed Processing and Preservation Centre, Trishal, Mymensingh, Seed Pathology Centre, Bangladesh Agricultural University, Mymensingh and Seed Testing Laboratory, Uttara, Dhaka of Supreme Seed Company Ltd. A seed lot having higher percentage of infection of *B. oryzae* was selected. The lot of Heera-1, a cultivar highly prone to seed born *B. oryzae* was used. Heera-2, Heera-5 and BRRI dhan29 was also included in this study. Seed treating fungicide Vitaflo 200FF (carboxin 17.5% & thiram 17.5%) was tested against *B. oryzae*. Two hundred gram seeds were taken from the test seed lot randomly. The lot with high level of infection of *B. oryzae* was used. The seed was dried in shade.

Both treated (with Vitaflo 200FF) and untreated seeds of Heera-1, Heera-2, Heera-5, and BRRI dhan29 were used. A total of 20 kg seed was taken at random. The sample was divided in to four parts and kept in two Jute bags and two poly bags separately. One half of both Jute bag and poly bag were stored in the laboratory under normal condition where temperature ranges was 11°C – 40^0C, and relative humidity 40% -98%. The other half was stored in the dehumidified chamber at 18±2°C and 40% RH for five years. Four hundred seeds from each treatment were taken at random for Germination of seeds.

Seed preservation

Table 1: Seed stored under different conditions

Treatment	Storage Condition	Storage Container
Untreated	Normal(Tem 11^0C- 40^0C) (RH 40%-98%)	Jute bag
		Poly bag
	Dehumidified(Tem 18±2°C) (RH 40%)	Jute bag
		Poly bag
Vitaflo 200FF (carboxin +thiram)	Normal(Tem 11°C- 40^0C) (RH 40%-98%)	Jute bag
		Poly bag
	Dehumidified(Tem 18±2°C) (RH 40%)	Jute bag
		poly bag

Seed Health test by blotter incubation methods

Four hundred seeds from each of the four seed sample were tested to examine the viability of *B. oryzae* on the infected seed. Blotter incubation method at four months' interval was used. Number of incubated seeds with the growth of *B. oryzae* was observed under sterio microscope at 25 X and counted according to the keys outlined by Mathur and Kongsdal (2003). The percentage of seeds with the growth of *B. oryzae* on each sample in each test was compared and the duration of viability was determined. The experiment was continued for five years. The percentage frequency of occurrence of *B. oryzae* fungi was calculated as follows:

$$\text{Incidence (\%)} = \frac{\text{Nos. of infected seeds}}{\text{Total Nos. of seeds}} x100$$

Germination capacity

Germination capacity was determined on sand media in plastic box ($8^{//}$ X $5^{//}$). Seed germinator was used for germination test. The procedure recommended by the International Seed Testing Rules (ISTA 1999) was followed. Number of normal seedlings, abnormal seedling, fresh un-germinated seed, hard seed and dead seed were counted. Every seedling was evaluated in accordance with the general principles laid down in ISTA Rules. The germination capacity was calculated by the following formula:

$$\text{Germination (\%)} = \frac{\text{Nubmer of normal seedlings}}{\text{Number of seeds tested}} \text{ X } 100$$

Seed treatment

Effect of solar heat treatment on germination of *B. oryzae* infected rice seeds during storage

About 5 kg seeds of a hybrid rice variety having high level of infection of *Bipolaris oryzae* were collected from the lot. Seeds were divided in to five equal quantities (D_1, D_2, D_3, D_4, D_5). The samples were subjected to solar heat treatment; D_1 for 1 hours, D_2 for 2 hours, D_3 for 4 hrs and D_4 for 6 hrs. Before sowing. Another one kg was used as D_5 as control (did not subjected to solar heat). The experiment was laid out in CRD. *B. oryzae* level was determined by Blotter incubation method. Percent seed-borne infection and germination was recorded.

Effect of seed soaking in water on germination of *B. oryzae* infected rice seeds during storage

About 5 kg seeds of a hybrid rice variety having high level of infection of *Bipolaris oryzae* were collected from the lot. Seeds were divided into five samples (S_1, S_2, S_3, S_4, S_5). The samples were submerged in water (soaking) S_1 for 8 hours, S_2 for 16 hours, S_3 for 24 hours and S_4 for 32 hours soaking. The seeds, one kg S_5 was used as control. *B. oryzae* was evaluated by blotter incubation method. Percent seed-borne infection and germination was recorded.

Effect of seed washing on germination of *B. oryzae* infected rice seeds during storage

About 5 kg seeds of a hybrid rice variety having high level of infection of *Bipolaris oryzae* was collected from the lot. Seeds were divided into five samples (C_1, C_2, C_3, C_4, C_5). The seeds were washed in water C_1 for one time, C_2 for twice, C_3 for 3 times and C_4 for 4 times. C_5 was maintained as control. The seeds were washed in running clean water at one-hour interval. The seeds were tested for health (blotter method) and germination was recorded.

Effect of chemical treatment on germination of *B. oryzae* infected rice seeds during storage

Three seed treating fungicides namely Provax 200 WP (Carboxin 37.50% & Thiram 37.50%), Vitaflo (Carboxin 17.5% & thiram 17.5%) and Bavistin (Carbendazim 50%) were tested against *Bipolaris oryzae*. Each of the fungicides was tested at 0.3% were taken in three different conical flasks, then distilled water was being poured in the conical flasks while it was shaken continuously and finally the volume of the solutions was made upto 100 ml. Thus 0.3% Vitaflo, Provax and Bavistin solutions were made and used for seed treatment. For seed treatment with fungicidal solutions the seeds were soaked in the solution for 1 hour. After 1 hour the fungicidal solutions were drained out and the moistened seeds were kept in the blotter paper to remove excess moisture from the seed surface. Two hundred gm seeds was taken from the test seed lot randomly. The lot which have high level of infection of *B. oryzae* was used. Treatment was followed to treat the seeds. The seeds were dried in shade. Four hundred seeds from each treatment was taken at random and was tested for the presence of seed-borne pathogen by blotter method. Germination of the treated seeds was also being evaluated by Germination test followed by ISTA rules 1999.

Effect of seed treatment with IPM bio-pesticide & BAU-biofungicide on the incidence of *B. oryzae* in/on hybrid rice seed

IPM bio pesticide and BAU- biofungicide (3g) were used which collected from IPM laboratory and Plant pathology department, BAU-Biofungicide (3g) was mixed with 100 ml water in a flask and dilutions were made and seeds were treated. The treated seeds were then kept for an hour and then subjected to the moist blotters in Petridishes. The treated seeds were allowed to be dried up on filter paper. Then the seeds were sown following the blotter method. A One kg seed of a hybrid rice variety having high level of infection of B. oryzae was collected from the lot. Seeds were taken in a plastic container. The pesticide was added and mixed well. The seeds were dried in shade for 24 hours. Seeds was sown in field soil on plastic box. 100 seed placement in each box with four replications. Emergence and seedling diseases were recorded. Incidence of *B. oryzae* was recorded by blotter incubation method. The experiment was laid out in CRD. Germination of the seeds was also being evaluated.

RESULTS AND DISCUSSION

Germination of *B. oryzae* infected rice seed

The percentage of normal seedling was 77%, 70%, 75% and 62% where the incidence of *B. oryzae* was 20%, 25%, 21% and 37%, in-case of Heera-1, Heera-2 (Photo 1 & 2), Heera-5 and BRRI dhan29, respectively (Fig. 1). When seed treatment with Vitaflo 200FF fungicide there was no infection of *B. oryzae* and thus germination was increased as 92%, 86%, 88% and 90% on Heera-1, Heera-2, Heera-5 and BRRI dhan29 respectively.

Photo1. Abnormal seedlings due to *B. oryzae*

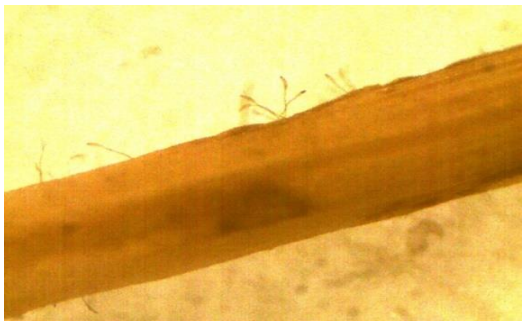

Photo: 2 *Bipolaris oryzae* on abnormal seedling

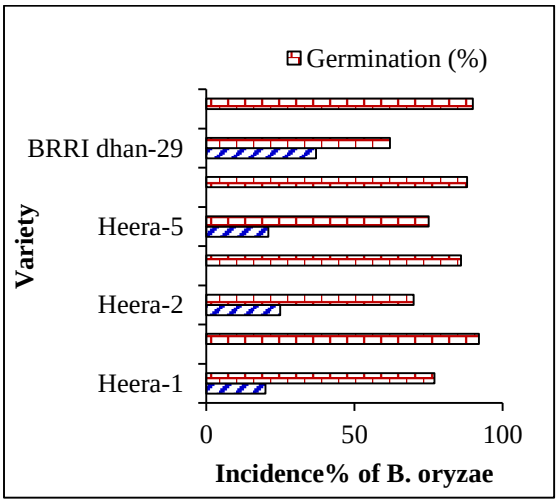

Fig. 1: Germination of *B.oryzae* infected seed (LSD 0.05% =6.14, 3.73 and 10.5)

Effect of seed treatment with Vitaflo 200FF on germination of *Bipolaris oryzae* infected rice seeds during storage

Heera-1

Germination of untreated Heera-1 seed samples which were highly infected with *B. oryzae* was decreased with increasing storage time. The germination of untreated seeds stored under normal

condition in jute bag was recorded as 70%, 72%, 65%, 55%, 50%, 45%, 44% 32%, 30%, 20% and 0%, which was tested at six months interval till five years (Table 2). Result was statistically similar up to one year. At 36th month storage the germination was sharply decreased. Finally, in 60th month the germination capacity was 0%, which was statistically significant. In poly bag germination result was statistically significant in 24th month of storage (Table 2).

The germination was recorded in 36th month 65%, in 42th month 52%, in 48th month 50%, in 54th month 40% and in 60th month 0%, which were statistically different. Similarly, when untreated seeds were stored under dehumidified condition in jute bag, the germination was 70%, 72%, 71%, 65%, 66%, 64%, 64% and 62% till five years. At 36th month 64% germination was recorded, and in 48th month to 60th month the germination was 62%. The untreated seeds stored under dehumidified condition in poly bag in 36th month showed 64% germination. In 60th month 65% germination was recorded, which was statistically similar to 48th month storage. When the seed sample was treated with Vitaflo fungicide and kept in polybag under dehumidified condition, 90% germination was recorded till 60th month, which was statistically similar to 54th month storage.

Table 2. Germination (%) of *Bipolaris oryzae* infected Heera-1 hybrid rice seed at storage

Seed treatment	Storage condition	Storage container	Germination (%) / Storage durations (months)											CV
			1st	6th	12th	18th	24th	30th	36th	42th	48th	54th	60th	(%)
Untreated	Normal (Tem 11^0-40^0c) (RH 40-98%)	Jute bag	70	72	65	55	50	45	44	32	30	20	00	6.59
		Poly bag	70	72	66	65	60	62	65	52	50	40	00	3.4
	Dehumidified (Tem 18±2^0C) (RH 40%)	Jute bag	70	72	71	65	65	66	64	64	62	62	62	3.4
		Poly bag	70	75	78	76	68	70	67	68	65	64	65	3.72
Treated	Normal (Tem 11^0-40^0c) (RH 40-98%)	Jute bag	92	90	88	84	80	70	65	60	58	40	00	4.16
		Poly bag	92	92	88	85	80	75	68	66	65	50	00	2.61
	Dehumidified (Tem 18±2^0C) (RH 40%)	Jute bag	92	90	91	89	88	86	87	87	86	85	85	2.45
		Poly bag	92	93	94	92	90	90	91	88	88	90	90	1.97
CV (%)			3.32	2.73	1.82	3.43	3.15	2.92	3.25	3.24	3.64	5.71	3.97	

Heera- 2

Germination of untreated Heera-2, highly infected with *B. oryzae* decreased significantly after 18 months of storage. In 24th month 68%, in 36th months 55%, in 48th month 38% and in 60th month 0.0% germination was recorded in case of jute bag storage (Table 3). The polybag stored seed germination was 68% in 18th month which decreased to 0.0% in 60th months. In case of dehumidified conditions seed samples in jute bag after 12th month showed 80% germination. Similar result was found till 60th month. When seed kept in polybag similar result was found till 48th months and differed significantly in 60th month. The seed treated with Vitaflo fungicide and stored in dehumidified condition in jute bag did not differ in germination till 60th month. The seeds kept in poly bag germinated 92% in 12th month, 91% in 24th month, 90% in 36th month 88% in 48th month and 86% in 60th month.

Heera 5

Heera-5 untreated hybrid rice seed when stored under normal condition in Jute bag, 70% germination was found till 12th months. At 18th month of storage germination decreased significantly to 55% in 36th month, 38% in 48th month and 0% in 60th month (Table 4). The seeds kept in poly bag gave 72% germination in 30th month and after 42nd month the germination decreased significantly til 60th months of storage. The seed stored in jute bag under dehumidified condition showed 70% germination till 48th month, 65% in 60th month. The polybag stored seed showed 70% germination and decreased thereafter. The Vitaflo treated seeds stored in normal condition gave lower germination in both containers in 60th month of storage. When seed samples stored in dehumidified condition 83% and 87% germination was recorded in jute bag and polybag, respectively.

Table 3. Germination (%) of *Bipolaris oryzae* infected Heera-2 hybrid rice seed during storage

Seed treatment	Storage condition	Storage container	Germination (%) / Storage durations (months)											CV
			1st	6th	12th	18th	24th	30th	36th	42th	48th	54th	60th	%
Untreated	Normal (Tem 11^0-40^0c) (RH 40-98%)	Jute bag	77	76	70	65	68	62	55	45	38	25	00	5.48
		Ploy bag	77	75	73	68	71	72	70	55	42	30	00	3.63
	Dehumidified (Tem 18±2^0C) (RH 40%)	Jute bag	77	78	80	75	73	72	72	72	70	68	65	3.33
		Polybag	77	80	82	82	81	81	78	80	81	76	70	2.42
Treated	Normal (Tem 11^0-40^0c) (RH 40-98%)	Jute bag	88	84	81	78	77	7	65	6	50	30	00	3.48
		Poly bag	88	85	84	80	78	75	72	65	56	42	00	3.8
	Dehumidified (Tem 18±2^0C) (RH 40%)	Jute bag	88	86	90	86	86	86	85	85	85	84	83	2.53
		Poly bag	88	90	92	92	91	88	90	91	88	87	86	3.3
CV (%)			2.64	3.24	2.67	2.67	3.29	2.8	4.28	2.64	2.77	4.75	4.06	

Table 4. Germination (%) of *Bipolaris oryzae* infected Heera-5 hybrid rice seed during storage

Seed treatment	Storage condition	Storage container	Germination (%)/ Storage conditions (months)											CV
			1st	6th	12th	18th	24th	30th	36th	42th	48th	54th	60th	%
Untreated	Normal (Tem 11^0-40^0c) (RH 40%-98%)	Jute bag	77	76	70	65	68	62	55	45	38	25	00	5.48
		Poly bag	77	75	73	68	71	72	70	55	42	30	00	3.88
	Dehumidified (Tem 18±2^0C) (RH 40%)	Jute bag	77	78	80	75	73	72	72	72	70	68	65	3.51
		Poly bag	77	80	82	82	81	80	78	80	8	76	70	3.63
Treated	Normal (Tem 11^0-40^0c) (RH 40%-98%)	Jute bag	88	84	81	78	77	70	65	63	50	3	00	3.9
		Poly bag	88	85	84	80	78	75	72	65	56	42	00	4.12
	Dehumidified (Tem 18±2^0C) (RH 40%)	Jute bag	88	86	90	86	86	86	85	85	85	84	83	2.43
		Poly bag	88	90	92	92	91	88	88	88	88	87	87	2.66
CV (%)			3.88	3.02	3.19	3.99	2.97	3.5	2.98	2.98	4.37	4.52	3.47	

BRRI dhan29

When untreated BRRI dhan29 seed samples kept in jute bag under normal condition 55% germination was recorded in 18th month, which was statistically similar with 1st, 6th and 12th month of storage and declined thereafter in both containers (Table 5). The seed stored in dehumidified conditions showed 62% germination in 1st month, 63% in 12th month, 58% in 24th month, 54% in 36th month, 50% in 48th month and 45% in 60th month. The seed treated with Vitaflo and stored under normal condition in jute bag gave 80% germination in 24th month and it decreased there after till 60th months. The seed stored in polybag gave similar result till 30th month declined from 36th month (75%) to 60th month. When seed stored in dehumidified condition in jute bag statistically similar result was observed till 24th months. From 30th months of stored result was decreased statistically till 60th month (0%). When seed kept in poly bag similar germination (87%) was found up to 24th month and it was declined from 30th month to 60th month. When treated seed stored in dehumidified condition, non-significant result was found in poly bag stored seed. Germination was recorded 88% in 60th months, whereas initial result was 90%. Germination was similar till 24th month and it was 80% in 60th month in jute bag.

Table 5. Germination (%) of *Bipolaris oryzae* infected BRRI dhan29 HYV rice seed during storage

Seed Treatment	Storage condition	Storage Container	Germination (%) / Storage durations											CV (%)
			1st	6th	12th	18th	24th	30th	36th	42th	48th	54th	60th	
Untreated	Normal (Tem 11^0-40^0c) (RH 40%-98%)	Jute bag	62	58	60	55	50	45	43	35	30	15	00	6.98
		Polybag	62	60	60	58	55	54	52	40	36	24	00	5.62
	Dehumidified (Tem 18 ± 2^0C) (RH 40%)	Jute bag	62	64	63	58	58	55	54	53	50	45	45	3.28
		Polybag	62	65	65	60	62	60	61	62	55	55	55	3.36
Treated	Normal (Tem 11^0-40^0c) (RH 40%-98%)	Jute bag	90	85	84	83	80	78	75	60	50	40	00	3.3
		Poly bag	90	89	88	88	87	82	80	78	65	53	00	2.72
	Dehumidified (Tem 18 ± 2^0C) (RH 40%)	Jute bag	90	85	87	85	84	82	82	82	82	82	80	2.75
		Poly bag	90	92	92	91	90	90	89	89	89	89	88	2.45
CV (%)			2.87	2.72	4.53	1.96	2.6	3.15	3.26	3.45	3.82	5.01	5.58	

The result supported by Gupta (2010) revealing that there was significant difference in the storability of paddy seeds under different storage conditions. Under LTLH storage conditions (temperature:15 °C and relative humidity:30%) paddy seeds maintained germination above the minimum seed certification standards (80%) up to 60 months after seed treatment as against 24 months when stored under ambient conditions. The germination of seeds stored under LTLH conditions in polylined (86.1%) and jute bags (75.3%) was significantly higher than seeds stored under ambient condition polylined 72.8% and jute bag 61.9% after 60 months of seed treatment. Seed treatment with thiram/captan also showed improved seed germination by 7% as against untreated control. Seed storage packages influenced the seed storability significantly. The seeds stored in polythene bag recorded higher germination throughout the storage. These seeds showed slow reduction in germination compared to jute bag. The electrical conductivity was higher with the seeds stored in jute bag. The superiority of seeds stored in poly bag for seed quality parameters was due to slow rate of deterioration, as the poly bags are moisture impervious, which might not have allowed the movement of moisture from the environment and hence not allowing the seeds to deteriorate at faster rate (Angamuthu 1996). Thiram (2.0 g/kg) treated seeds maintained higher seed germination throughout the storage.

The percentage of normal seedling was recoded 77%, 70%, 75% and 62% in-case of Heera-1, Heera-2, Heera-5 and BRRI dhan29 whereas incidence of *B. oryzae* was observed 20%, 25%, 21% and 37%, respectively. Besides this lower incidence of *Alternaria* sp. and *Curvularia* sp. were found within the samples. Abnormal seedling was recorded as 23%, 20%, 17% and 28% in Heera-1, Heera-2, Heera-5 and BRRI dhan29, respectively. The nature of damage caused by *B. oryzae* differed with different stages. At the time of storage it usually affected seed quality parameters like germination, viability and vigour. At the time of seed germination, it affected both root and shoot system and survivability of seedlings by causing seedling blight (Huyunh and Gaur 2004). Zad and Khosravi (2000) also reported the association of seed borne fungi with abnormal seedlings of rice, which supported the results and also confirmed by Guerrero *et al.* (1972). Abnormal seedlings were transferred to the top of blotter paper and incubated under NUV light for inducing sporulation. *B. oryzae* was found in seed abundantly after incubation. Some times in few cases *A. padwikii* was also seen simultaneously along with *B. oryzae.* Roles of other fungi associated with abnormal seedlings have not been indicated unknowingly in producing abnormal seedlings, because of their low and inconsistent frequency of occurrence.

Effect of different treatment on germination of *Bipolaris oryzae* infected hybrid rice seed

The seeds treated with solar heat, soaking, washing, Provax, Vitaflo, IPM bio pesticide and BAU fungicide showed significant effect on germination (Fig. 2). Highest germination was observed with Vitaflo fungicide (88 to 92%) followed by Provax (83 to 92%), BAU fungicide (81 to 84%) and IPM biopesticide (80 to 84%). Seed washing (75 to 80%) was more effective than solar heat (72 to 80%), seed soaking in water (70 to 78%) and Bavistin (70-78%). Seed treatments especially with fungicides like

Captan, Thiram or Mancozeb restrict the growth of mycloflora on the seeds and maintain better seed viability (Gupta 2003).

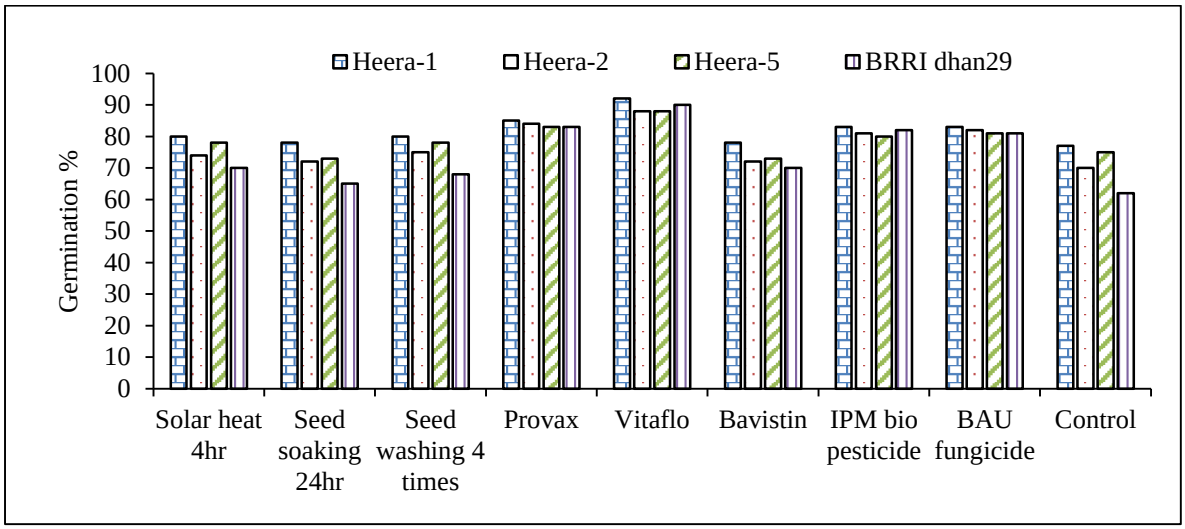

Fig.2: Effect of different treatment on germination of *B. oryzae* infected rice seed (LSD $_{0.05\%}$ =6.47, 5.72, 5.48 & 6.25 for Heera-1, Heera-2, Heera-5 and BRRI dhan29).

All the treatments showed influence on the control of *B. oryzae* of hybrid rice seeds over control though Vitaflo resulted excellent effect in controlling seed-borne fungal pathogens and Provax, BAU fungicides, IPM biopesticides and seed washing were also found good for controlling seed-borne pathogens of hybrid rice seeds. Bavistin was not such effective against *B. oryzae.*

LITERATURE CITED

Ahmed, M.F., Khalequzzaman, K.M., Islam, M.N., Anam, M.K. and Islam, M.T. 2000. Effect of fungicides against *Bipolaris oryzae* of rice under in vitro condition. Pakistan J. Plant Pathol. 1(1): 4-7.

Angamuthu, K. 1996. Studies on hybrid rice seed production and storage technology in rice. Seed Tech. News. 26:4-5.

Fakir, G.A., Hossain, I., Ahmad, M.U., Ahmed, M., Asad-ud-doula and Alam, M.M. 2002. Quality of Farmer's Boro and T aman Rice seeds collected before sowing from Bogra Rajshahi and Rangpur district of Bangladesh in the proceeding of the 2002 planning meeting of the Rice seed health Improvement Sub-project.2 p

Guerrero, F.C., Mathur, S.B. and Neergaard, P. 1972. Seed health testing of rice. Seed-borne fungi associated with abnormal seedling of rice. Proceedings of the Int. Seed Testing Assoc. 37: 985-997.

Gupta, A. 2003. Role of seed mycoflora in deterioration of soybean seed during storage under ambient conditions. *In*: Singh DP (Editor). Implications of Plant Diseases on Produce Quality. Kalyani Publishers, Ludhinia, India. 85-96pp

Gupta, A. 2010. Storage Technologies to enhance Longevity in Paddy (Oryza sativa L) Seed of Parental Lines IR58025A and IR58025B of hybrid PRH-10. East African J. Sci. 4(2): 106-113.

Huynh, V. N. and Gaur, A. 2004. Role of *Bipolaris oryzae* in producing abnormal Seedling of rice (*Oryza sativa*). Omonrice. 12: 102-108.

ISTA. 1999. International Rules for Seed Testing Association. Seed Sci. and Technol. 4: 4247.

Kamal, M.M. and Mia, M.A.T. 2009. Diversity and Pathogenicity of the rice brown spot pathogen *Bipolaris oryzae* (BRREDA DE HAAN) SHOEM in Bangladesh assessed genetic fingerprint analysis. Bangladesh J.Bot.,38 (2):119-125.

Malavolta, V.M.A., Parisi, J.J.D., Takada, H.M and Martins, M.C. 2002. Effect of different incidence levels of *Bipolaris oryzae* in rice seeds on physiological aspects, Seedling Transmission and production. Summa Phytopathologica. 28 (4): 336-340.

Mathur, S.B. and Kongsdal, O. 2003. Common Laboratory Seed Health Testing Methods for Detecting Fungi. Danish Govt. Institute of Seed Pathology for Developing Countries

Copenhagen, Denmark.Published by ISTA, Switzerland. 425 pp

Mew, T.W. and Gonzales. 2002. A handbook of Rice Seed borne fungi. Science Publishers. IRRI. Metro Manila. 83 p.

Mia, M.A.T. and Nahar, M. A. 2001. Status of rice seed health in Bangladesh and farmer's seed production and management scenario. In Seed health and seed associated microorganisms for rice diseases management. TW Mew and B cotyn (Eds) pp 81-86. Limited Proceedings no 6. International Rice Research Institute, Los Banos.

Mia, M.A.T., Begum, J.A., Haque, S.M.A., Rahman, S.M.M., Rahman, A.C., Diaz, F., Elazegui, M and Mew, T.W. 2004. Improved methods of seed production, drying and preservation farmer's level. Paper presented in the National Workshop on Seed Health Improvement Sub-project on 7 July 2004 at BARC.

Naeem, K., Anwar, S.A., Riaz, M.I. and Khan, M.S.A. 2001. Seed-borne fungi and bacteria of rice and their impact on seed germination. Pakistan J. Phytopath. 13(1):75-81

Parisi, J.J.D., Malavolta, V, M.A and Leonel, F.L. 2001. Chemical control of seed-borne fungi in rice seeds (*Oryza sativa* L.). Summa Phyto Pathologica. 27(4): 403-409.

Zad, S.J. and Khosravi, V. 2000. Investigation on important seed borne fungal diseases of dominant rice cultivars in Mazandaran (Iran) Proceedings 52nd International Symposium on Crop Protection, Gent, Belgium. pp 587-592.